surfaces to the center section. Examples of such grooves are shown in U.S. Pat. No. 5,102,379.

The journal and gear are typically made of steel. Both may be made of the same steel, which is typically case-hardened by carburization. Commonly used steels include AMS 6265 and AMS 6308. In an exemplary embodiment, the surfaces **66** are formed by or covered with a bearing material such as a bronze coating. In the exemplary embodiment, the surfaces **64** are covered with a lubricous coating. Advantageously the coating is of a solid film coating material. A preferred coating is MoS_2-based. MoS_2 may applied by a physical vapor deposition (PVD). One example is sputtering. Such coating technology is available from several commercial suppliers, including Hohman Plating and Mfg., Inc., Dayton, Ohio. As applied, the coating may have an exemplary thickness between 0.3 and 3.0 μm. More preferably, such thickness may be between 1.0 and 2.0 μm. During use and prior to subsequent remanufacture or repair, the coating may wear and the thickness may be substantially reduced. Modified versions of this basic coating are discussed in "The Effects of Dopants on the Chemistry and Tribology of Sputter-Deposited MoS_2 Films" J. S. Zabinski, M. S. Donley and S. D. Walck, Tribology Transactions, Vol. 38, 1995, pp. 894–904, the disclosure of which is incorporated by reference herein as if set forth at length. One possible dopant combination is antimony and gold.

Another example is cathodic arc deposition. One such MoS_2-based coating involves fullerene-like MoS_2. Such coatings are disclosed in "Thin Films of Fullerene-Like MoS_2 Nanoparticles with Ultra-Low Friction and Wear" Manish Chhowalla & Gehan A. J. Amaratunga, Nature, Vol. 407, 2000, pp. 164–167, the disclosure of which is incorporated by reference herein as if set forth at length. That reference discloses deposition utilizing a localized high-pressure arc discharge. High pressure nitrogen gas is introduced via a hole in an MoS_2 target which is in turn ablated by cathodic arc discharge. The ablation generates fullerene-like nanoparticle MoS_2 which is carried by expansion from the high pressure region near the discharge to the journal being coated. The nanoparticles are characterized by curvature of the S—Mo—S planes to form irregularly shaped particles. Specifically, in conventional MoS_2 the atoms are arranged in a hexagonal lattice. Each lattice cell consists of six (prismatic) side faces and two (basal) end faces. Normally, these crystallographic planes are atomistically flat. However, when the atoms are forcibly displaced from their equilibrium (low energy) positions by energetic ions, the S—Mo—S atomic bonds will be stretched and result in distorted crystallographic planes. For example, the coating will tend to be formed of generally circular particles compared with sputtered particles tending to form columnar grains oriented substantially normal to the surface to which the coating is applied. The structure may be viewed by high-resolution transmission electron microscopy (HREM) and the associated lattice strain revealed by a shift of the (0002) peak in the x-ray diffraction (XRD) spectrum. Namely, the (0002) peak in the spectrum is located at a relatively low angle compared to that of a sputtered MoS_2 coating (e.g., at an angle of 8° compared to 13°). This shift indicates lattice expansion. Thus when so observed the fullerene-like coatings would be expected to typically have (000) peaks closer to 8° than to 13°.

Alternative MoS_2 coating application techniques include resin bonding of MoS_2 particles and thermal spray techniques.

Particularly promising test results have been observed for the fullerene-like MoS_2 and the essentially pure sputtered MoS_2. These appear to provide a particularly advantageous combination of load and duration performance in tests simulating a failure of an oiling lubrication system.

One or more embodiments of the present invention have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. For example, assemblies may replace individual parts or vice versa. The principles may be applied both to various existing engines and transmissions and engines and transmissions yet to be developed. Accordingly, other embodiments are within the scope of the following claims.

What is claimed is:

1. A turbofan engine comprising:

a turbine;

a fan; and

a geartrain coupling the turbine to the fan to permit the turbine to drive the fan with a reduction and including a plurality of gears of which at least a first gear is supported by a journal, the journal having a coating comprising MoS_2.

2. The engine of claim **1** wherein the fan is forward of the turbine and has an operated bypass ratio of at least 4.0.

3. The engine of claim **1** wherein the coating comprises sputter-deposited MoS_2.

4. The engine of claim **3** wherein the coating consists essentially of sputter-deposited MoS_2.

5. The engine of claim **1** wherein the coating comprises fullerene-like MoS_2.

6. The engine of claim **1** wherein the coating has an XRD (0002) peak of about 8°.

7. The engine of claim **1** wherein the journal comprises a steel element on which said coating is deposited.

8. The engine of claim **1** wherein the reduction is between 2.2:1 and 3.5:1.

9. The engine of claim **1** wherein the coating consists essentially of arc-deposited MoS_2.

10. The engine of claim **1** wherein the coating has a thickness between 1.0 and 2.0 μm.

11. The engine of claim **1** wherein the coating has a thickness between 0.3 and 3.0 μm.

12. The engine of claim **1** wherein:

the journal is further oil-lubricated in addition to the existent MoS_2 coating.

13. The engine of claim **12** wherein:

the coating consists essentially of fullerene-like MoS_2.

14. A turbofan engine comprising:

a turbine;

a fan; and

a geartrain coupling the turbine to the fan to permit the turbine to drive the fan with a reduction and including a plurality of gears of which at least a first gear is supported by a journal, the journal having a coating consisting essentially of at least one of sputter-deposited MoS_2 and fullerene-like MoS_2.

15. The engine of claim **14** wherein the first gear has a journal-engaging surface coated with bronze.

16. The engine of claim **14** wherein the journal is further normally oil lubricated in addition to said coating and said coating provides extended operation after a loss of said oil in an abnormal condition.

* * * * *